PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-282964

(43)Date of publication of application : 03.10.2003

(51)Int.Cl. H01L 35/22
C01G 53/00
H01L 35/18
H01L 35/34

(21)Application number : 2002-080258

(22)Date of filing : 22.03.2002

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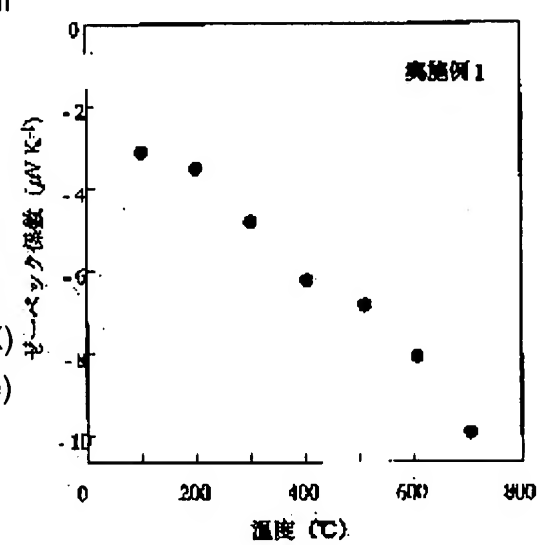
(54) COMPLEX OXIDE HAVING n-TYPE THERMOELECTRIC CHARACTERISTICS

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a novel material having an excellent performance as an n-type thermoelectric conversion material.

SOLUTION: A complex oxide contains a composition represented by the formula: $La_{1-X}M_XNiO_{2.7}$ to 3.3 (wherein M is at least one type of element selected from the group consisting of Na, K, Li, Zn, Pb, Ba, Ca, Al, Nd, Bi and Y, and x is $0.01 \leq x \leq 0.8$) or the formula: $(La_{1-X}M_X)_2NiO_{3.6}$ to 4.4 (wherein M and x are the same as above) and has a negative Seebeck coefficient at 100°C or higher.



LEGAL STATUS

[Date of request for examination] 18.06.2003

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] General formula: The multiple oxide which has the presentation expressed with La1-XMXNiO 2.7-3.3 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.01<=x<=0.8 among a formula.), and has a Seebeck coefficient negative at the temperature of 100 degrees C or more.
[Claim 2] General formula: The multiple oxide which has the presentation expressed with La1-XMXNiO 2.7-3.3 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.01<=x<=0.8 among a formula.), and has the electrical resistivity of 10 or less momegacm at the temperature of 100 degrees C or more.
[Claim 3] General formula :(La1-XMX) 2 Multiple oxide which has the presentation expressed with NiO 3.6-4.4 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.01<=x<=0.8 among a formula.), and has a Seebeck coefficient negative at the temperature of 100 degrees C or more.
[Claim 4] General formula :(La1-XMX) 2 Multiple oxide which has the presentation expressed with NiO 3.6-4.4 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.0 <=1x <=0.8 among a formula.), and has the electrical resistivity of 10 or less momegacm at the temperature of 100 degrees C or more.
[Claim 5] n mold thermoelectrical conversion ingredient which consists of a multiple oxide according to claim 1 to 4.
[Claim 6] The thermoelectric generation module containing n mold thermoelectrical conversion ingredient according to claim 5.

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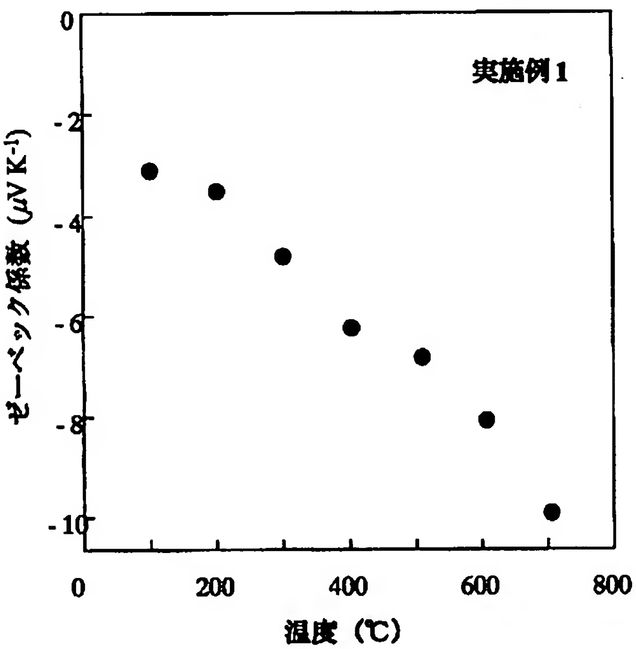
Drawing selection Representative drawing



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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to n mold thermoelectrical conversion ingredient using the multiple oxide and this multiple oxide which have the engine performance which was excellent as an n mold thermoelectrical conversion ingredient.
[0002]
[Description of the Prior Art] In our country, it did not pass over the yield of the effective energy from primary supply energy to about 30%, but, finally it has discarded about 70% of energy in atmospheric air as heat. Moreover, it is discarded in atmospheric air, without also changing into other energy the heat produced by combustion in works, an incinerator plant, etc. Thus, we the human beings have discarded very much heat energy vainly, and have gained only slight energy from actions, such as combustion of fossil energy.
[0003] In order to raise the yield of energy, it is effective to carry out as [use / the heat energy discarded in atmospheric air]. The thermoelectrical conversion which transforms heat energy into direct electrical energy for that purpose is an effective means. This thermoelectrical conversion is an energy conversion method which uses the Seebeck effect and generates electricity by producing the potential difference by giving a temperature gradient at the both ends of a thermoelectrical conversion ingredient. In this thermoelectric generation, it arranges in the elevated-temperature section which produced the end of a thermoelectrical conversion ingredient with waste heat, an end is already arranged in atmospheric air (room temperature), the electrical and electric equipment is obtained only by connecting lead wire to each both ends, and mobiles, such as a motor required for a general generation of electrical energy and a turbine, are unnecessary at all. For this reason, cost is also cheap, and there is also no discharge of the gas by combustion etc., and it can generate electricity continuously until a thermoelectrical conversion ingredient deteriorates.
[0004] Thus, although thermoelectric generation is expected as a technique which bears the end of solution of the energy problems about which it will worry from now on, in order to realize thermoelectric generation, it has high thermoelectrical conversion efficiency and it is necessary to supply the thermoelectrical conversion ingredient excellent in thermal resistance, chemical durability, etc. in large quantities.
[0005] The CoO_2 system stratified oxide of calcium$3Co_4O_9$ grade is reported as matter in which the thermoelectrical engine performance which was excellent in hot air is shown until now. However, all of these oxide are the ingredient which it has the thermoelectrical property of p mold and a Seebeck coefficient shows a forward value, i.e., the ingredient with which the part located in an elevated-temperature side serves as the low voltage section.
[0006] In assembling the thermoelectric generation module using a thermoelectrical conversion operation, n mold thermoelectric generation ingredient other than p mold thermoelectrical conversion ingredient is usually needed. It excels in thermal resistance, chemical durability, etc., and n mold thermoelectrical conversion ingredient which has high thermoelectrical conversion efficiency is not

found out until now, but from thermoelectricity which used waste heat for this reason has still come [however,] to be put in practical use.
[0007] Then, there is little toxicity, and it is constituted by the element with much abundance, it excels in thermal resistance, chemical durability, etc., and development of n mold thermoelectrical conversion ingredient which moreover has high thermoelectrical conversion efficiency is expected.
[0008]
[Problem(s) to be Solved by the Invention] This invention is made in view of the trouble of the above-mentioned conventional technique, and the main purpose is offering the new ingredient which has the engine performance which was excellent as an n mold thermoelectrical conversion ingredient.
[0009]
[Means for Solving the Problem] this invention person came to complete this invention for the multiple oxide of the specific presentation by which the part was permuted by the specific element including La, nickel, and O as an essential element being what has a negative Seebeck coefficient and has the property which was low and was moreover excellent as an n mold thermoelectrical conversion ingredient a header and here, as a result of repeating research wholeheartedly that the above-mentioned technical problem should be attained. [of the electric resistance value]
[0010] That is, this invention offers n mold thermoelectrical conversion ingredient which used a following multiple oxide and this following multiple oxide.
1. General formula : multiple oxide which has presentation expressed with La1-XMXNiO 2.7-3.3 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.01<=x<=0.8 among formula.), and has Seebeck coefficient negative at temperature of 100 degrees C or more.
2. General formula : multiple oxide which has presentation expressed with La1-XMXNiO 2.7-3.3 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.01<=x<=0.8 among formula.), and has electrical resistivity of 10 or less momegacm at temperature of 100 degrees C or more.
3. General formula :(La1-XMX) 2 Multiple oxide which has the presentation expressed with NiO 3.6-4.4 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.01<=x<=0.8 among a formula.), and has a Seebeck coefficient negative at the temperature of 100 degrees C or more.
4. General formula :(La1-XMX) 2 Multiple oxide which has the presentation expressed with NiO 3.6-4.4 (M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and is 0.0 <=1x <=0.8 among a formula.), and has the electrical resistivity of 10 or less momegacm at the temperature of 100 degrees C or more.
5. n mold thermoelectrical conversion ingredient which becomes either of above-mentioned terms 1-4 from multiple oxide of publication.
6. Thermoelectric generation module which contains n mold thermoelectrical conversion ingredient of publication in above-mentioned term 5.
[0011]
[Embodiment of the Invention] The multiple oxide of this invention is the multiple oxide (henceforth "a multiple oxide 1") which has the presentation expressed with general formula:La1-XMXNiO 2.7-3.3, or an oxide (henceforth "a multiple oxide 2") which has the presentation expressed with general formula: (La1-XMX)2NiO 3.6-4.4. In the above-mentioned multiple oxide 1 and a multiple oxide 2, M is a kind of element chosen from Na, K, Li, Zn, Pb, Ba, calcium, aluminum, Nd, Bi, and Y at least, and x is 0.01 or more and 0.8 or less value.
[0012] As for the potential which produces the above-mentioned multiple oxide 1 and the above-mentioned multiple oxide 2 with thermoelectromotive force when the both ends of the ingredient which all has a negative Seebeck coefficient and consists of this oxide are made to produce a temperature gradient, the direction of an elevated-temperature side becomes high compared with a low temperature side, and the property as an n mold thermoelectrical conversion ingredient is shown. The above-mentioned multiple oxide 1 and a multiple oxide 2 all have a negative Seebeck coefficient in the

temperature of 100 degrees C or more, for example, specifically, have an about [-1--20microVK-1] Seebeck coefficient at the temperature of 100 degrees C or more.
[0013] Furthermore, the above-mentioned multiple oxide 1 and a multiple oxide 2 have good electrical conductivity, and show low electrical resistivity, and it is the electrical resistivity of 10 or less momegacm in the temperature of 100 degrees C or more.
[0014] Among the above-mentioned multiple oxides 1, the X diffraction pattern of the multiple oxide obtained in the example 1 mentioned later is shown in drawing 1 , and the X diffraction pattern of the multiple oxide further obtained in the example 56 later mentioned among multiple oxides 2 is also shown in drawing 1 .
[0015] From these X diffraction patterns, although existence of an impurity is observed somewhat, a multiple oxide 1 has the crystal structure of a perovskite mold, and it is admitted that a multiple oxide 2 is a thing which is the related substance of perovskite and which has the so-called stratified perovskite type structure.
[0016] The mimetic diagram of the crystal structure of a multiple oxide 1 and a multiple oxide 2 is shown in drawing 2 . As shown in drawing 2 , a multiple oxide 1 has the LaNiO triad of a perovskite mold, a part of La site is permuted by M, as for a multiple oxide 2, it has La2NiO4 structure of a stratified perovskite mold, and a part of La site is permuted by M.
[0017] The above-mentioned multiple oxide 1 and a multiple oxide 2 can be manufactured by mixing and calcinating a source material so that it may become the metal component ratio of the multiple oxide made into the purpose, and the same metal component ratio. That is, the target multiple oxide can be obtained by mixing and calcinating a source material so that it may become the metal component ratio of La, M, and nickel in above-mentioned general formula:La1-XMXNiO 2.7-3.3 (the inside of a formula, M, and x are the same as the above), or general formula:(La1-XMX)2NiO 3.6-4.4 (the inside of a formula, M, and x are the same as the above).
[0018] As a source material, especially if an oxide can be formed by baking, it will not be limited, but a metal simple substance, an oxide, various compounds (carbonate etc.), etc. can be used. As a source of La, for example, a lanthanum trioxide (La 2O3), a carbonic acid lanthanum (La2(CO3) 3), A lanthanum nitrate (La3 (NO3)), a lanthanum chloride (LaCl3), lanthanum hydroxide (La3 (OH)) and an alkoxide compound (a dimethoxy lanthanum (La3 (OCH3)) --) It can be used. a diethoxy lanthanum (La3 (OC2H5)), a dipropoxy lanthanum (La3 (OC3H7)), etc. -- etc. -- as a source of nickel Nickel oxide (NiO), nickel nitrate (nickel2 (NO3)), a nickel chloride (NiCl2), Nickel hydroxide (nickel2 (OH)), alkoxide compounds (dimethoxy nickel (nickel2 (OCH3)), diethoxy nickel (nickel2 (OC2H5)), dipropoxy nickel (nickel2 (OC3H7)), etc.), etc. can be used. An oxide, a chloride, a carbonate, a nitrate, a hydroxide, and an alkoxide compound can be similarly used about other elements. Moreover, the compound containing two or more sorts of configuration elements of the multiple oxide of this invention may be used.
[0019] What is necessary is just to calcinate about burning temperature and firing time, for 20 hours to about 40 hours, for example in an about 850-1000-degree C temperature requirement that what is necessary is just to consider as the conditions in which the target multiple oxide is formed, although not limited especially. In addition, when using a carbonate, an organic compound, etc. as a source material, after carrying out temporary quenching beforehand and making a source material disassemble before calcinating, it is desirable to calcinate and to form the target multiple oxide. For example, what is necessary is just to calcinate on the above-mentioned conditions as a source material, after carrying out temporary quenching at about 600-800 degrees C for about 10 hours in using a carbonate.
[0020] Especially a baking means is not limited but can adopt the means of arbitration, such as an electric heating furnace and a gas heating furnace. Among an oxygen air current, although it is good, a firing environments can also usually be calcinated for example, in an inert atmosphere, among the oxidizing atmosphere of the air middle class then when a source material contains the oxygen of an amount enough.
[0021] The amount of oxygen in the multiple oxide to generate is controllable by the oxygen tension at the time of baking, burning temperature, firing time, etc., and it can make high the rate of an oxygen

ratio in the above-mentioned general formula, so that oxygen tension is high.
[0022] Thus, all, the multiple oxide 1 and multiple oxide 2 of this invention which are obtained have a negative Seebeck coefficient, and have the low electrical resistivity of 10 or less momegacm at the temperature of 100 degrees C or more, and can demonstrate the thermoelectrical conversion engine performance in which it excelled as an n mold thermoelectrical conversion ingredient. Furthermore, thermal resistance, chemical durability, etc. are good, this multiple oxide is constituted by few toxic elements, and its practicality is high as a thermoelectrical conversion ingredient.
[0023] The multiple oxide 1 and multiple oxide 2 of this invention can be effectively used using the above-mentioned property as an n mold thermoelectrical conversion ingredient used at an elevated temperature into air.
[0024] The mimetic diagram of an example of the thermoelectric generation module using the thermoelectrical conversion ingredient which consists of a multiple oxide of this invention as an n mold thermoelectric element is shown in drawing 3 . The structure of this thermoelectric generation module is the same as that of a well-known thermoelectric generation module, it is the thermoelectric generation module constituted with the substrate for the elevated-temperature sections, the substrate for the low-temperature sections, p mold thermoelectrical conversion ingredient, n mold thermoelectrical conversion ingredient, an electrode, lead wire, etc., and the multiple oxide of this invention is used as an n mold thermoelectrical conversion ingredient.
[0025]
[Effect of the Invention] The multiple oxide of this invention has a negative Seebeck coefficient and low electrical resistivity, and is a multiple oxide excellent in thermal resistance, chemical durability, etc. further.
[0026] This multiple oxide can be effectively used with the conventional intermetallic compound using such a property as an impossible n mold thermoelectrical conversion ingredient used in hot air. Therefore, it becomes possible by incorporating this multiple oxide into a system as an n mold thermoelectric element of a thermoelectric generation module to use effectively the heat energy discarded in atmospheric air until now.
[0027]
[Example] Hereafter, an example is given and this invention is further explained to a detail.
[0028] After fully mixing a source material as a source of example 1La as a carbonic acid lanthanum ($La2(CO3)$ 3) and a source of nickel, using potassium carbonate ($K2CO3$) as nickel oxide (NiO) and a source of K so that it may be set to La:nickel:K(element ratio) =0.8:1.0:0.2, it put into the alumina crucible, and using the electric furnace, in air, temporary quenching was carried out for 10 hours, and 600 degrees C of carbonates were decomposed. This temporary-quenching object was ground, after pressing, it calcinated at 920 degrees C in the oxygen air current for 40 hours, and the multiple oxide was compounded.
[0029] The obtained multiple oxide was what is expressed with empirical formula:La0.8K0.2NiO3.2.
[0030] The graph which shows the temperature dependence of the Seebeck coefficient (S) in 100 degrees C - 700 degrees C of the obtained multiple oxide is shown in drawing 4 . It has checked that they were n die materials to which this multiple oxide has a negative Seebeck coefficient in the temperature of 100 degrees C or more, and an elevated-temperature side serves as high potential from drawing 4 .
[0031] In addition, also in all the following examples, a Seebeck coefficient is a negative value in 100 degrees C or more, and the inclination to fall with the rise of temperature as well as an example 1 was shown.
[0032] Moreover, the graph which shows the temperature dependence of electrical resistivity is shown in drawing 5 about this multiple oxide. Drawing 5 shows that the electrical resistivity of this multiple oxide is a low value on all the range of 100-700 degrees C, and of 10 or less momegacm.
[0033] The source material was mixed so that it might become the element ratio of La:M:nickel shown in an example 2 - 110 following Table 1 - 4, and the multiple oxide was compounded like the example 1.

[0034] As a source material, in addition to the raw material used in the example 1, as a source of Na A sodium carbonate (Na2CO3), As a source of Li, as a lithium carbonate (Li2CO3) and a source of Zn, a zinc oxide (ZnO), As a source of Pb, as a lead oxide (PbO) and a source of Ba, a barium carbonate (BaCO3), As a source of calcium, yttrium oxide (Y2O3) was used as the bisumuth oxide (Bi 2O3) and a source of Y as oxidization neodium (Nd 2O3) and a source of Bi as an aluminum oxide (aluminum 2O3) and a source of Nd as a calcium carbonate (CaCO3) and a source of aluminum.
[0035] About burning temperature, it set up in 850-920 degrees C according to the multiple oxide made into the purpose.
[0036] Among the obtained multiple oxides, the multiple oxide of examples 1-55 has the LaNiO triad of a perovskite mold, a part of La site was permuted by M, as for the multiple oxide of examples 56-110, it has La2NiO4 structure of a stratified perovskite mold, and a part of La site was permuted by M.
[0037] The element ratio of each element in the obtained multiple oxide, the Seebeck coefficient in 700 degrees C, and the electrical resistivity in 700 degrees C are shown in following Table 1 - 4.
[0038]
[Table 1]

一般式：$La_{1-x}M_xNiO_Y$

No.	M	La:M:Ni:O	ゼーベック係数 700℃ (μVK⁻¹)	電気抵抗率 700℃ (mΩ cm)
1	K	0.8 : 0.2 : 1 : 3.2	-10	8
2	K	0.95 : 0.05 : 1 : 3.3	-8	5
3	K	0.9 : 0.1 : 1 : 3.2	-5	7
4	K	0.5 : 0.5 : 1 : 3.1	-4	4
5	K	0.2 : 0.8 : 1 : 3.3	-3	4
6	Na	0.99 : 0.01 : 1 : 3.2	-7	7
7	Na	0.95 : 0.05 : 1 : 3	-7	5
8	Na	0.9 : 0.1 : 1 : 2.9	-3	8
9	Na	0.5 : 0.5 : 1 : 3.0	-12	4
10	Na	0.2 : 0.8 : 1 : 2.8	-5	6
11	Li	0.99 : 0.01 : 1 : 3.1	-18	8
12	Li	0.95 : 0.05 : 1 : 3.2	-10	9
13	Li	0.9 : 0.1 : 1 : 2.8	-5	7
14	Li	0.5 : 0.5 : 1 : 2.7	-8	4
15	Li	0.2 : 0.8 : 1 : 3.1	-3	7
16	Zn	0.99 : 0.01 : 1 : 2.8	-7	8
17	Zn	0.95 : 0.05 : 1 : 3.2	-8	5
18	Zn	0.9 : 0.1 : 1 : 2.7	-5	6
19	Zn	0.5 : 0.5 : 1 : 3.3	-8	4
20	Zn	0.2 : 0.8 : 1 : 3.2	-3	5
21	Pb	0.99 : 0.01 : 1 : 3.0	-10	8
22	Pb	0.95 : 0.05 : 1 : 2.9	-9	5
23	Pb	0.9 : 0.1 : 1 : 3.1	-5	3
24	Pb	0.5 : 0.5 : 1 : 3.0	-7	4
25	Pb	0.2 : 0.8 : 1 : 2.8	-2	9
26	Ba	0.99 : 0.01 : 1 : 3.2	-11	8
27	Ba	0.95 : 0.05 : 1 : 3.3	-7	5
28	Ba	0.9 : 0.1 : 1 : 3.1	-5	6

[0039]
[Table 2]

一般式：$La_{1-x}M_xNiO_Y$

No.	M	La:M:Ni:O	ゼーベック係数 700℃ (μVK⁻¹)	電気抵抗率 700℃ (mΩ cm)
29	Ba	0.5 : 0.5 : 1 : 2.8	-4	4
30	Ba	0.2 : 0.8 : 1 : 2.9	-3	8
31	Ca	0.99 : 0.01 : 1 : 3.1	-12	8
32	Ca	0.95 : 0.05 : 1 : 3.0	-8	6
33	Ca	0.9 : 0.1 : 1 : 3.3	-6	7
34	Ca	0.5 : 0.5 : 1 : 3.2	-4	4
35	Ca	0.2 : 0.8 : 1 : 2.8	-7	7
36	Al	0.99 : 0.01 : 1 : 3.2	-10	8
37	Al	0.95 : 0.05 : 1 : 2.9	-8	5
38	Al	0.9 : 0.1 : 1 : 3.1	-8	7
39	Al	0.5 : 0.5 : 1 : 3.0	-6	4
40	Al	0.2 : 0.8 : 1 : 3.3	-5	6
41	Nd	0.99 : 0.01 : 1 : 2.9	-12	8
42	Nd	0.95 : 0.05 : 1 : 2.9	-9	7
43	Nd	0.9 : 0.1 : 1 : 3.1	-5	6
44	Nd	0.5 : 0.5 : 1 : 2.8	-4	4
45	Nd	0.2 : 0.8 : 1 : 3.1	-3	4
46	Bi	0.99 : 0.01 : 1 : 3.2	-10	8
47	Bi	0.95 : 0.05 : 1 : 3.0	-8	3
48	Bi	0.9 : 0.1 : 1 : 2.8	-7	7
49	Bi	0.5 : 0.5 : 1 : 2.9	-4	5
50	Bi	0.2 : 0.8 : 1 : 3.0	-4	4
51	Y	0.99 : 0.01 : 1 : 3.2	-10	9
52	Y	0.95 : 0.05 : 1 : 3.3	-8	5
53	Y	0.9 : 0.1 : 1 : 3.2	-5	4
54	Y	0.5 : 0.5 : 1 : 3.0	-8	4
55	Y	0.2 : 0.8 : 1 : 2.8	-3	2

[0040]
[Table 3]

一般式：$(La_{1-x}M_x)_2NiO_Y$

No.	M	La:M:Ni:O	ゼーベック係数 700℃ (μVK⁻¹)	電気抵抗率 700℃ (mΩcm)
56	Na	1.98 : 0.02 : 1 : 3.7	-11	9
57	Na	1.9 : 0.1 : 1 : 3.9	-8	7
58	Na	1.8 : 0.2 : 1 : 3.8	-4	7
59	Na	1 : 1 : 1 : 3.8	-7	6
60	Na	0.4 : 1.6 : 1 : 4.0	-3	4
61	K	1.98 : 0.02 : 1 : 3.9	-9	8
62	K	1.9 : 0.1 : 1 : 4.1	-8	9
63	K	1.8 : 0.2 : 1 : 3.6	-6	7
64	K	1 : 1 : 1 : 3.7	-4	7
65	K	0.4 : 1.6 : 1 : 4.2	-5	8
66	Li	1.98 : 0.02 : 1 : 4.4	-11	8
67	Li	1.9 : 0.1 : 1 : 3.8	-8	5
68	Li	1.8 : 0.2 : 1 : 3.7	-9	7
69	Li	1 : 1 : 1 : 3.8	-4	5
70	Li	0.4 : 1.6 : 1 : 4.1	-5	4
71	Zn	1.98 : 0.02 : 1 : 4.2	-10	8
72	Zn	1.9 : 0.1 : 1 : 4.0	-7	7
73	Zn	1.8 : 0.2 : 1 : 3.9	-5	7
74	Zn	1 : 1 : 1 : 3.8	-4	4
75	Zn	0.4 : 1.6 : 1 : 4.1	-9	9
76	Pb	1.98 : 0.02 : 1 : 4.2	-10	8
77	Pb	1.9 : 0.1 : 1 : 3.7	-11	7
78	Pb	1.8 : 0.2 : 1 : 3.9	-5	7
79	Pb	1 : 1 : 1 : 3.8	-5	4
80	Pb	0.4 : 1.6 : 1 : 4.2	-3	4
81	Ba	1.98 : 0.02 : 1 : 4.3	-6	8
82	Ba	1.9 : 0.1 : 1 : 4.2	-8	6
83	Ba	1.8 : 0.2 : 1 : 4.4	-12	7

[0041]
[Table 4]

一般式：$(La_{1-x}M_x)_2NiO_Y$

No.	M	La:M:Ni:O	ゼーベック係数 700℃ (μVK⁻¹)	電気抵抗率 700℃ (mΩcm)
84	Ba	1 : 1 : 1 : 3.9	-4	4
85	Ba	0.4 : 1.6 : 1 : 3.8	-16	4
86	Ca	1.98 : 0.02 : 1 : 3.9	-10	8
87	Ca	1.9 : 0.1 : 1 : 4.1	-3	9
88	Ca	1.8 : 0.2 : 1 : 4.2	-5	7
89	Ca	1 : 1 : 1 : 4.3	-7	4
90	Ca	0.4 : 1.6 : 1 : 4.0	-3	8
91	Al	1.98 : 0.02 : 1 : 3.9	-10	8
92	Al	1.9 : 0.1 : 1 : 3.8	-6	5
93	Al	1.8 : 0.2 : 1 : 4.0	-5	7
94	Al	1 : 1 : 1 : 4.1	-4	6
95	Al	0.4 : 1.6 : 1 : 3.8	-4	4
96	Nd	1.98 : 0.02 : 1 : 4.0	-10	8
97	Nd	1.9 : 0.1 : 1 : 3.9	-12	7
98	Nd	1.8 : 0.2 : 1 : 3.7	-5	7
99	Nd	1 : 1 : 1 : 4.2	-4	8
100	Nd	0.4 : 1.6 : 1 : 3.8	-4	4
101	Bi	1.98 : 0.02 : 1 : 4.1	-13	8
102	Bi	1.9 : 0.1 : 1 : 4.0	-4	6
103	Bi	1.8 : 0.2 : 1 : 4.2	-5	7
104	Bi	1 : 1 : 1 : 3.9	-9	8
105	Bi	0.4 : 1.6 : 1 : 4.3	-3	4
106	Y	1.98 : 0.02 : 1 : 4.0	-10	8
107	Y	1.9 : 0.1 : 1 : 4.1	-8	5
108	Y	1.8 : 0.2 : 1 : 3.9	-7	7
109	Y	1 : 1 : 1 : 4.0	-4	4
110	Y	0.4 : 1.6 : 1 : 4.1	-5	9

[Translation done.]